

1 predetermined diameter D, the center of said second generally circular solder pad being spaced
2 from the center of said first generally circular solder pad by a predetermined spacing distance
3 BL;

4 c. a solder bar pad of a first predetermined bar width BW formed upon the upper surface
5 of the first substrate connecting said first circular solder pad to said second circular solder pad,
6 the first predetermined bar width BW being less than the first predetermined diameter D;

7 d. a mass of reflowable solder having a solder bar volume VB formed over the first and
8 second generally circular solder pads and over said solder bar pad to form said reflowable
9 solder bar, the solder bar volume VB reaching a height H1 above the centers of said first and
10 second generally circular solder pads, and reaching a height H2 above a midpoint of said solder
11 bar pad;

12 e. wherein the values for predetermined diameter D, spacing distance BL, predetermined
13 bar width BW, and solder bar volume VB are selected in such manner that H1 and H2 are
14 approximately equal.

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REMARKS

17 Claims 16-22 are currently pending. Claims 16-22 were initially rejected by the
18 Examiner under 35 U.S.C. §103(a) as describing subject matter considered by the Examiner to
19 have been obvious to those skilled in the art based upon U.S. Patent No. 5,796,169 (Dockerty)
20 in view of U.S. Patent No. 6,118,182 (Barrow) and U.S. Patent No. 5,011,066 (Thompson).
21 Claim 16 has been amended above to more particularly define Applicants' invention.
22 Reexamination of the present application, and reconsideration of the rejection of claims 16-22
23 is respectfully requested in view of the above amendment to claim 16 and in view of the
24 following remarks.

25 Claim 16 as amended recites that the present invention includes "a mass of reflowable
26 solder having a solder bar volume VB". In contrast, the cited patent to Dockerty details the
27 formation of "high melting temperature support solder" (see Dockerty, col. 2, lines 45-53) used
28 to form thermal path between a substrate and a printed circuit board. However, Dockerty's

1 “high melting temperature support solder” differs in composition from the lower-temperature,
2 reflowable solder that actually make the electrical interconnections between Dockerty’s ball
3 grid array and the metal contacts formed on the printed circuit board (see Dockerty, col. 3, lines
4 16-36). As Dockerty notes, high melting temperature solder might have a melting temperature
5 of 310 degrees Centigrade, whereas a reflowable solder might have a melting temperature of
6 180 degrees Centigrade. Dockerty notes that support solder 6 is composed of 90/10 lead/tin
7 high melting temperature solder; see Dockerty, col. 3, lines 57-60. Dockerty further explains
8 that the high melting temperature support solder 6 is pressed into a solder paste 12 formed of
9 resin and a low melting temperature solder, and then solder paste 12 is reflowed to connect
10 support solder 6 to contact 8 of printed circuit board 1; see Dockerty, col. 3, line 60, to col. 4,
11 line 10. Likewise, at col. 4, lines 36-58, Dockerty explains that the support solders 16, 17 and
12 18 of Figs. 3 and 4 are composed of high melting point solder such as 90/10 lead/tin alloy.
13 Dockerty further explains that such support solders are attached to IC device bonding pads by
14 utilizing low melting temperature solder 20. Similarly, Dockerty notes that support solder 33
15 (including the L-shaped depiction at 14 in Fig. 3) is made of high melting temperature solder,
16 whereas electrical connections to the underlying copper contacts on printed circuit board 1 are
17 accomplished through the reflow of a low temperature solder; see Dockerty, col. 5, lines 41-48.

18 From the foregoing, it should be clear that Dockerty does not disclose or suggest the use
19 of a lower melting temperature reflowable solder to form a solder bar.

20 In addition, claim 16 clearly states that the solder bar pad over which the solder bar is
21 formed has a bar width BW that is less than the diameter D of the first and second generally
22 circular solder pads. Dockerty, on the other hand, stresses the importance of matching the
23 cross-section of the support solder (at least along one axis) to the cross-section of the solder
24 balls; see, for example, col. 2, lines 18-22; col. 2, lines 32-36; col. 2, lines 48-51; and
25 particularly, col. 2, lines 54-59. Thus, Dockerty clearly requires, as a “key structural feature”,
26 that the cross section of the support solder match the cross section of the solder balls. Rather
27 than being a “matter of design choice”, as argued by the Examiner, such dimensions are “a key
28 structural feature”, according to the Examiner’s principal reference, Dockerty. However,

1 Dockerty's requirement for such matching is directly contrary to the limitation of claim 16
2 requiring that the solder bar pad width BW be less than the diameter D of the generally circular
3 end pads.

4 In an effort to show that it would somehow be obvious to reduce the width of
5 Dockerty's support solder along the central portion of its length, the Examiner also cites the
6 Barrow patent. However, unlike the claimed invention and Dockerty, Barrow lacks any solder
7 bar pad under the central solder mass. Moreover, Barrow teaches the use of rectangular solder
8 end pads when forming elongated solder structures, whereas both the claimed invention and
9 Dockerty use circular end pads having the same radius of curvature as the solder ball pads. If
10 one skilled in the art were to attempt to apply the teachings of Barrow to the solder support of
11 Dockerty, the resulting structure would have rectangular end pads, no solder bar pad, and the
12 narrowing of the cross section in the central region between the end pads would violate the key
13 structural feature of Dockerty. Accordingly, it would not have been obvious to combine the
14 teachings of Barrow with the Dockerty structure; even if one attempted to do so, the resulting
15 structure would not provide the structure recited by claim 16 as amended.

16 The Examiner's comments regarding the Thompson patent are not understood, as
17 Thompson does not form a solder bar structure. Solder joint 206 in Fig. 2c is circular.

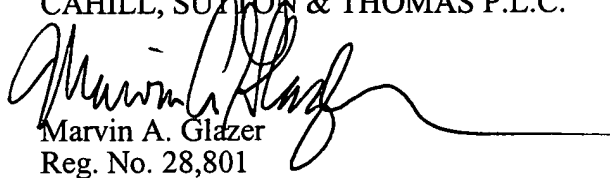
18 For the reasons set forth above, Applicants submits that the invention defined by claim
19 16 as amended, and by claims 17-22 which depend therefrom, recite subject matter that would
20 not have been obvious to those skilled in the art from the references cited by the Patent
21 Examiner. Accordingly, Applicants respectfully submit that the present application is in
22 condition for allowance, which action is earnestly requested.

23 A clean copy of amended claim 16, including the corrections, is attached hereto.
24 Applicants have already set forth above a marked-up version of amended claim 16, noting the
25 inserted text by underlining.

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Respectfully submitted,

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16. A reflowable solder bar formed upon an upper surface of a first substrate, the first substrate having a first electrical contact, said reflowable solder bar being adapted to join the first electrical contact to a second electrical contact on a second substrate, said reflowable solder bar comprising in combination:

- A¹
- a. a first generally circular solder pad formed upon the upper surface of the first substrate, the first generally circular solder pad having a center, and having a first predetermined diameter D;
 - b. a second generally circular solder pad formed upon the upper surface of the first substrate, the second generally circular solder pad having a center, and having said first predetermined diameter D, the center of said second generally circular solder pad being spaced from the center of said first generally circular solder pad by a predetermined spacing distance BL;
 - c. a solder bar pad of a first predetermined bar width BW formed upon the upper surface of the first substrate connecting said first circular solder pad to said second circular solder pad, the first predetermined bar width BW being less than the first predetermined diameter D;
 - d. a mass of reflowable solder having a solder bar volume VB formed over the first and second generally circular solder pads and over said solder bar pad to form said reflowable solder bar, the solder bar volume VB reaching a height H1 above the centers of said first and second generally circular solder pads, and reaching a height H2 above a midpoint of said solder bar pad;
 - e. wherein the values for predetermined diameter D, spacing distance BL, predetermined bar width BW, and solder bar volume VB are selected in such manner that H1 and H2 are approximately equal.

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